

glower, as is well known, is made of a mixture of oxides similar to those used in the manufacture of Welsbach mantles, which are mixed to a paste and then pressed through a die into threads of the desired thickness. These threads are cut into convenient lengths and baked, after which leading-in wires are affixed to the ends. This connection, as originally made by Dr. Nernst, consisted of a few turns of platinum wire twisted round the ends of the glower and cemented to it by a suitable paste; the terminal connection worked out by the Westinghouse Company has the platinum lead wire terminating in a small bead which is actually embedded in the end of the glower, the object being to prevent any shrinking of the glower spoiling the contact between it and the platinum. It has often been stated that if the current through a glower be altered, the potential difference between its ends falls as the current is increased. The curves published by Mr. Wurts show that for a glower burning in air this statement is not quite correct; the curves only give the characteristic of the glower between 0.3 and 0.65 ampere, but they show that as the current is increased from 0.3 to 0.5 ampere the potential difference rises also, from 180 to 197 volts; the potential difference remains constant as the current is further increased up to 0.55 ampere, after which it begins to fall slightly. It is, however, quite evident that if the glower is run anywhere near the crest of this curve, as is the case in practice, a steadying series resistance is essential, especially on a circuit in which the voltage fluctuates, as it does on all the supply circuits with which we are acquainted.

In the above respect the glower behaves in a manner comparable with the arc rather than with the carbon filament. The behaviour is generally accounted for by saying that the glower being an electrolytic conductor becomes less resisting as its temperature is increased. That the phenomenon is, however, more complex than this is shown by the characteristics of the glower in other gases than air, or in a vacuum. For a glower burning in oxygen the characteristic appears to be almost identical with the air curve; when nitrogen is used the curve is similar in shape, but the maximum voltage occurs at a lower current and is about 4 per cent. less in magnitude. The characteristics for hydrogen and a vacuum show only a falling curve; there is no portion within the same current limits in which the potential difference rises with the current. These results seem to indicate that some chemical changes are going on between the glower and its surrounding envelope of gas which have an important influence on its behaviour and very possibly on its efficiency and life. There can be little doubt that when the Nernst lamp is easily available it will open up a field of research as interesting and possibly as fruitful as that afforded by the electric arc.

The work of M. Blondel and Mrs. Ayrton has made us familiar with the physical necessity of a resistance in series with the arc on account of its falling characteristic. Such a resistance is still more necessary with the Nernst glower—since a smaller overload of current is more dangerous. With an arc a comparatively small "dead" resistance in series is sufficient, that is to say a resistance which remains of practically constant value throughout the working range of current and does not heat sufficiently with a small overload to alter appreciably. But with the glower it is easy to see, from the curves published by Mr. Wurts, that if a dead resistance were used it would have to be so large for safety as to greatly diminish the efficiency of the complete lamp. A resistance has therefore had to be sought which will increase very rapidly with increase of current, and the solution of the difficulty has been found in using fine iron wire nearly at a red heat, the wire being enclosed in a small sealed bulb filled with hydrogen to prevent its oxidation. This "ballast," as it is named by the Westinghouse Company, has a remark-

ably high corrective power; with a rise in current of 15 per cent. the resistance increases about 180 per cent., the potential difference between its terminals increasing 200 per cent. As a consequence with such a ballast in series with the glower, a rise in the supply pressure does not produce a serious increase in the current. It follows also that the Nernst lamp (consisting of glower and ballast) cannot be overrun in the same way as an incandescent lamp in order to get it to give more than its rated candle-power or to work at a higher efficiency. With an increase of the supply pressure of 5 per cent. the candle-power of an incandescent lamp increases 40 per cent., whereas that of the Nernst lamp only rises about 7 per cent., the corresponding increase in efficiency being 26 per cent. and 2 per cent. respectively. It is obvious that as this result is attained by running the iron wire nearly at a red heat, the resistance of the ballast when cold is considerably lower than its correct working resistance, and there is therefore a tendency for the glower to take too much current when it first lights up. The ballast has for this reason to be constructed in such a way that the iron wire shall very quickly assume its full resistance, a requisite satisfied by the free suspension of the wire in the hydrogen bulb.

Mr. Wurts does not give any curves showing the candle-power and efficiency during the life of the glower, a thing to be regretted, as it is by the performance of the lamp in this respect that it must ultimately stand or fall. It is, however, stated that the average life of 220-volt glowers on a by no means over steady alternating circuit was found to be from 800 to 900 hours, and that neither the efficiency nor the candle-power fell off much during this life. The life of the 110-volt glowers is said not to be so good, and the average life of the glowers on direct current is given as only about 250 to 300 hours. It should not be assumed that this is an inherent defect, as the Westinghouse Company have devoted their attention mainly to alternating current, and since the German company make lamps for either type of supply it seems evident that the difficulty can be overcome.

We have done no more than indicate a few of the many interesting considerations raised by Mr. Wurts' paper; it contains in addition descriptions of the heater, of the cut-out used for breaking the heater circuit when the glower lights, and of the complete lamp as now constructed in America. Suffice it to say that the lamps are made in candle-powers from 50 to 2000, the higher candle-powers being obtained, not by the use of a larger glower, but by mounting a number of glowers in parallel in the same lamp. Smaller candle-powers than 50 have not been made, as it has been deemed advisable to design the lamp to compete with the arc rather than with the incandescent lamp. In conclusion, we must agree with Mr. Steinmetz, the president of the American Institute, that the lamp should not be compared too severely with existing standardised lamps since, as it is just fresh from the laboratory, it is to its promise rather than to its performance that one should look. And there can be little question but that its promise is exceptionally good.

FLORAS OF THE PAST.¹

THIS "extract" from the twentieth annual report of the U.S. Geological Survey forms a bulky volume of more than 200 pages and 150 plates. Prof. Lester Ward tells us in the introductory remarks that the aim of the memoir is "to give a succinct account of the progress thus far made in the direction of developing the Mesozoic floras of the United States." The present instalment deals with the vegetation of the Triassic and Jurassic

¹ "Status of the Mesozoic Floras of the United States." First Paper: The Older Mesozoic. By Lester F. Ward, with the collaboration of W. M. Fontaine, A. Warner and F. H. Knowlton. Pp. 211-430 + Plates xxi-clxxxix. (Washington: Government Printing Office, 1900.)

periods, the Cretaceous floras being reserved for a second part. The numerous scattered references to the Mesozoic botany of the United States, and the conflicting opinions that have been expressed as to the geological age of the plant-bearing beds, enable us to thoroughly appreciate the value of a comprehensive report compiled by one who possesses a wide knowledge of palæobotanical literature. It is, however, not solely with published facts that the volume is concerned, for a large portion of it is devoted to a systematic account of recently discovered species. The Triassic floras are represented by fossils from the Connecticut Valley, Pennsylvania, Maryland, Virginia and other regions, while plants of Jurassic age are described from California, Oregon and Wyoming. One of the chief desiderata from the point of view of palæobotanical research is a careful and critical examination of the records of ancient floras, which may be of use in the consideration of the broad problems connected with plant evolution and distribution. In the treatment of work of this kind it is essential to carefully weed out such material as cannot be determined with sufficient accuracy to furnish trustworthy evidence. This obvious reflection is suggested by a perusal of the numerous determinations and descriptions contained in the volume before us. It is unfortunate that the plants from the Jurassic strata of California (the Oroville flora) are in most cases represented by fragmentary samples, and in several instances these have been referred to genera and species on evidence which cannot be accepted as satisfactory. Systematic work on fossil plants has too frequently been marred by a want of self-control on the part of authors who appear to be led away by a desire to attach names to specimens that are absolutely valueless as botanical records; we are compelled to add that the utility of the descriptive portions of this work is seriously impaired through lack of courage to discard worthless material. More than eighty specimens of cycadean stems are recorded from the Freezeout Hills of Wyoming—probably of Jurassic age. These stems are referred by Prof. Ward to a new genus, *Cycadella*, which is described as being characterised by the relatively small size of the trunks and by a dense covering of ramental tissue "exuberantly developed from the leaf-bases and extruded from the armour, massed and matted in the fossil state so as to form a thick outer covering." The exceptional development of the ramental scales suggests a comparison with the abundance of woolly hairs on the carpophylls of the recent cycadean genus *Dioon*, and constitutes an interesting feature which may serve as an index of climatal conditions.

The characters on which the cycadean stems are referred to distinct species are hardly such as to deserve specific recognition, and in looking over the numerous plates devoted to the specimens, one fails to appreciate the advantages gained by the reproduction of more than a hundred photographs, in most cases exhibiting only surface features which are often indistinctly shown and give little or no information of botanical value. Prof. Ward admits that the characters made use of in his classification are not the most satisfactory for diagnostic purposes, but we would urge that in the absence of more useful characteristics, such as might be obtained from an examination of the anatomy of the petrified stems, the application of specific names serves no useful purpose, but rather tends to confusion. Little information is given in regard to the reproductive organs; these are described as being less numerous than in other fossil cycads, but they appear to agree in position and in form with those of the *Bennettites* type.

There is no more striking feature of the Mesozoic vegetation of the United States than the extraordinary abundance of silicified cycadean stems, and no more valuable contribution could be made to our knowledge of extinct types than a comparative morphological account

of the vegetative and reproductive organs of the American fossil cycadales. A foretaste of what may be expected has been supplied by Mr. Wieland, who has already published some descriptions of the reproductive organs of cycadean plants in the large collection at Newhaven; it is an extension of this kind of work that is urgently needed and for which there appears to be no lack of material.

Some pieces of coniferous wood are described by Mr. Knowlton and referred by him to *Araucarioxylon*? *obscurum*, n.sp., but in this case also the data are insufficient to justify the adoption of a distinctive specific name.

Apart from these criticisms as to the methods adopted in the systematic part of the work, we can cordially congratulate Prof. Ward on the completion of the first part of a research which must be of great value to students of palæobotany.

A. C. S.

NOTES.

WE are glad to notice that the daily Press is endorsing what we have for years been endeavouring to bring home to the nation, viz. a better appreciation of the advantages of science and of scientific training. A notable instance of this is to be found in a leader in the *Times* of Monday last on the anniversary of Trafalgar, in the course of which our contemporary, in speaking of the recent naval disasters and breakdowns, says that these mishaps "suggest, if they do not indicate, some failure of competence, some lack of coordinating intelligence, among those who are responsible for the structural perfection of our warships. If this were so, it would tend to show that the national failing of which we have seen too many evidences of late, of neglect of scientific training, of the practical man's contempt for scientific method, of self-satisfied contentment with the traditional, the makeshift and the second best, is beginning to find its way into the constructive and engineering departments of the Admiralty." "We have heard much of late," remarks our contemporary, "about the need for 'standardising' our machines. Let us try if we cannot 'standardise' our educational methods and our intellectual equipment generally—not, indeed, according to the 'standards' of the Education Department, but according to the standard of the best that is known, and thought, and done in the world. In the Navy of to-day," says the *Times*, "there is zeal, capacity, energy and devotion in all respects worthy of the heroic past. The only thing that seems to be wanting is what is wanting in the nation, belief in knowledge and faith in applied intelligence." We trust that at this time, when we are being outstripped in many directions by foreign rivals, and commercial invasion has come to our very doors, and orders for machinery, railway locomotives, &c., are going in increasing numbers to our more energetic and receptive kinsmen across the sea, such words of warning as we have quoted will receive due attention and be acted upon ere it be too late.

THE question of fogs in London is at last, we are glad to see, to receive attention. The General Purposes Committee of the London County Council having had under consideration a letter from the secretary of the Meteorological Office, stating that it is proposed to hold an inquiry into the occurrence and distribution of fogs in the London district and their relation to other atmospheric and local conditions, and asking for the co-operation of the Council in the conduct of the inquiry, propose "(1) That a gentleman of suitable scientific qualifications be engaged by the Meteorological Council for a limited period, to formulate instructions and a scheme of observations, and to conduct the investigation; (2) that the observations be taken at the various Fire Brigade stations, and by men of the Fire Brigade; and also, if it can be so arranged, at other institutions of the London County Council; (3) that the returns be sent from the various stations, and from any other institutions selected, direct to the